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Kodak



SCIENTIFIC
and TECHNICAL
DATA BOOK

P-37

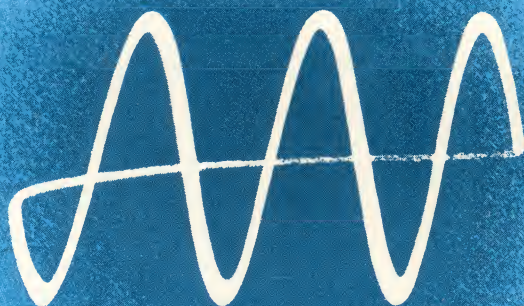
K O D A K

F I L M S

F O R

CATHODE-RAY TUBE

R E C O R D I N G



Kodak Films For

Cathode-Ray Tube Recording

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How the Films
Were Tested

Phosphors

Spectral
Sensitivity

Relative
CRT Speeds

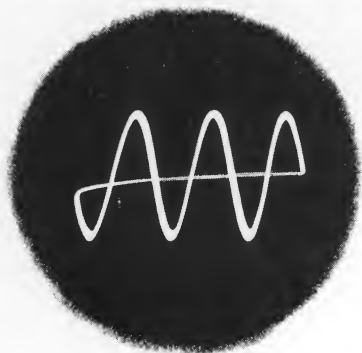
Characteristic
Curves

Image-Structure
Characteristics

Rapid Processing —
Emulsion Hardness

Sizes and Ordering
Information





- The use of cathode-ray tubes to display information which is then recorded by photographic means has become very important in recent years. In addition to its use for conventional oscillography, cathode-ray tube photography is also used in such areas as television recording, radar recording applications, electronic computers, and the recording of messages transmitted from remote locations. The information presented in this book is intended only as a guide in selecting the film which will be best suited to your particular application.

Some of the tube characteristics which influence the results are:

1. Spectral emittance of the phosphor used in the cathode-ray screen
2. The decay rate of the phosphor
3. Spot size of the trace
4. Beam current and voltage applied to the tube
5. Sweep rates

Film characteristics which also influence the results include:

1. Spectral sensitivity
2. Film speed
3. Reciprocity characteristics
4. Graininess and modulation transfer characteristics

The final selection of a film for a specific application should be made on the basis of practical tests that use the actual equipment involved and the processing conditions required.

HOW THE FILMS WERE TESTED

Much of the sensitometric data for the films was obtained by using a special cathode-ray tube sensitometer. This sensitometer uses as a light source a cathode-ray tube with an appropriate phosphor screen.

Excitation of the phosphor was in the form of a television raster (525 lines, 60 fields per second, 2-1/2 x 3-1/4-inch size). The raster was covered by a photographic silver step tablet placed in contact with the face of the tube. The step tablet was then imaged onto the film with an $f/2.3$ lens of 100mm focal length. The exposure was adjusted to the speed of a particular film both by varying the beam current of the cathode-ray tube, and by varying the exposure time. Wherever the speed of the film allowed it, exposure was to a single television frame (two interlaced fields), lasting 1/30 second over-all. The actual exposure time on each point of the film was very

short, depending on the transit time of the electron beam past a given point of the phosphor (about 0.05 microseconds); on the subsequent decay time of the phosphor; and on the amount of scattering in the step tablet. For slow films, exposure to several successive fields was necessary.

In each case an exposure identical to that given the film under test was also made on Eastman Television Recording Film, Type 5374. Although the Type 5374 film was thus sometimes overexposed or underexposed — depending on the speed of the other material — a portion of its characteristic curve could always be determined. This made possible a direct comparison of the relative speeds of the two materials (over at least a portion of the curves) for the particular exposure condition used.

After exposure, the films were developed in a carefully-controlled, sensitometric processing machine. A development time of 4 minutes in Kodak Developer D-19 at 68 F (20 C), with continuous agitation, was adopted for all films. Because of the differences in the development rates for the various films, this resulted in considerable variation in contrasts, as shown by the curves. If the development times had been adjusted to produce the same degree of development with all the films, there would, of course, have been some changes in relative speed values. However, this test procedure does give a useful comparison of the characteristics of the films.

It is realized that in any practical application requiring the utmost in film speed, extended development will undoubtedly be used. To demonstrate the effect of a longer development time, a few of the faster films were developed for 15 minutes in Kodak Developer D-19 at 68 F (20 C) with continuous agitation.

The resulting densities of the sensitometric strips were read on a densitometer, and D-log E curves were plotted. Each curve was corrected to remove the effects of small variations in phosphor emission over the field covered by the step tablet.

PHOSPHORS

There is a great variety of phosphors used in cathode-ray screens. For practical reasons, the information in this book is given only for those phosphors that are most commonly photographed. These phosphors and their general characteristics are given in Table I on page 5.

Table I. PHOSPHOR CHARACTERISTICS

SCREEN TYPE	PERSISTENCE	DECAY TIME* (IN MICRO-SECONDS)	COLOR		WAVE-LENGTH OF PEAK RADIANT ENERGY	APPLICATIONS	REMARKS
			FLUORESCENCE	PHOSPHORESCENCE			
P4	Medium or medium-short	112 14,000	White	White or blue-white	4500 Å 5800 Å	Television picture tubes	Some P4 fluorescent powders are available with a silica coating for burn resistance.
P11	Short	30	Blue	Blue	4550 Å	Special oscilloscope for photographic recording	Produces a brilliant actinic spot. Widely used for photographic recording.
P15	Extremely short	1.7	Blue-green and near-ultraviolet	Blue-green and near-ultraviolet	5100 Å	Flying-spot scanners or special oscilloscopes	Helpful for high-resolution, high-frequency, continuous-motion recording. Not as actinic as P11.
P16	Extremely short	0.1	Violet and near-ultraviolet	Violet and near-ultraviolet	3850 Å	Flying-spot scanners	Has stable exponential decay.
P24	Extremely short	2.5	Light green	Light green	4900 Å	Color flying-spot scanners	

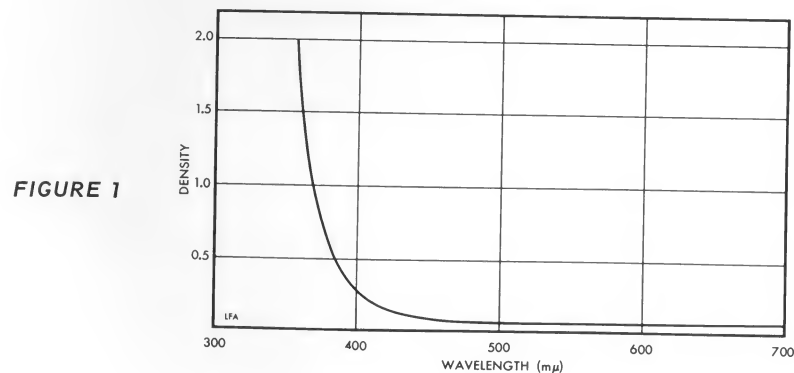
* Decay time of a cathode-ray tube phosphor is usually measured as the time it takes for the light intensity to fall from its full value to 1/e (36.8 percent) of the full value. Sometimes, however, it is measured as the time required for the light intensity to fall to 10 percent of the full value. The decay times given in this table are to 1/e of the full value.

SPECTRAL SENSITIVITY

The relative speeds of two films in a given recording situation will, of course, depend greatly upon the basic film speeds. Beyond this, the most important single factor appears to be the spectral sensitivity of the emulsion in relationship to the spectral emittance of the phosphor. This phosphor emittance is generally limited to a rather narrow region of the spectrum. It is easy to go astray in predicting the effects of shifting from one phosphor to another unless attention is paid to details.

For example, one might think that the two blue-sensitive films, Eastman High Speed Positive Film, Type 5305, and Eastman Television Recording Film, Type 5374, would have about the same speeds relative to each other for both P-16 and P-11 phosphors, since the peak emittance of each phosphor lies generally in the same region of the spectrum. Actually, while the Type 5305 film is 3.6 times as fast as Type 5374 when exposed to the P-11 phosphor, it is 6 times as fast when exposed to the P-16 phosphor.

The spectral transmission of the recording lens is also an important factor. This is particularly true when an ultraviolet-emitting phosphor, such as P-16, is used, because most glass starts to absorb strongly in the nearultraviolet. The spectral transmission of the lens used in obtaining the relative speeds listed in this book is shown in Figure 1. The effects of this lens are included in the speed numbers.



Blue-Sensitive

FIGURE 2

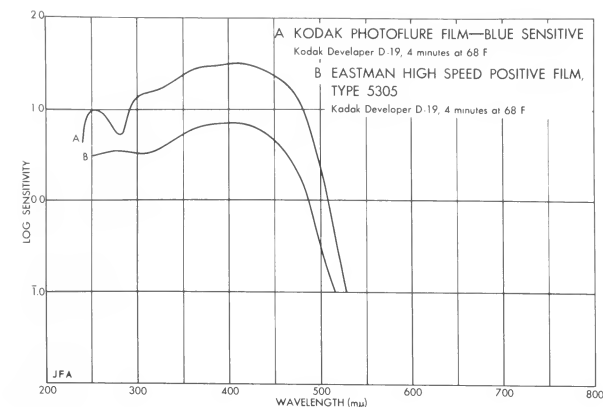
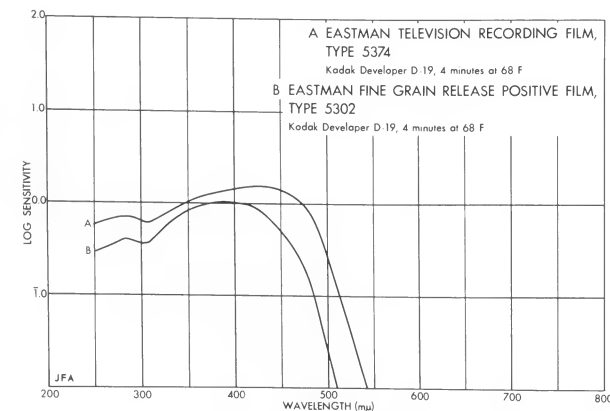


FIGURE 3



Orthochromatic

FIGURE 4

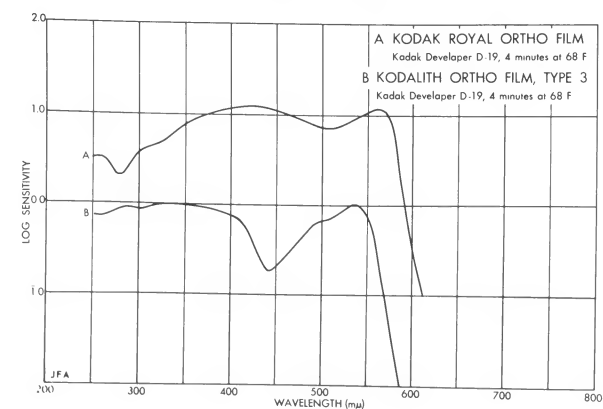
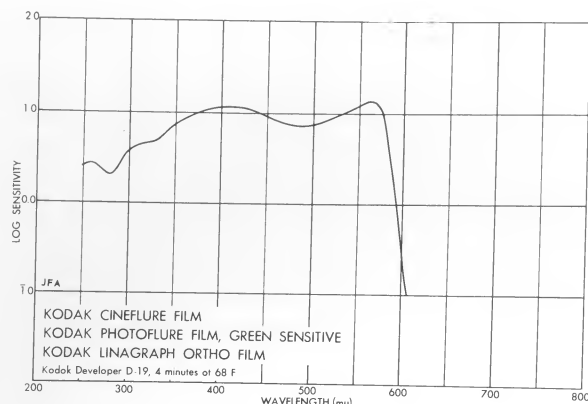


FIGURE 5



Panchromatic

FIGURE 6

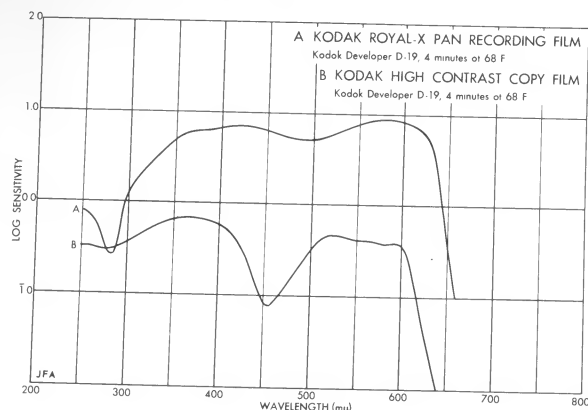
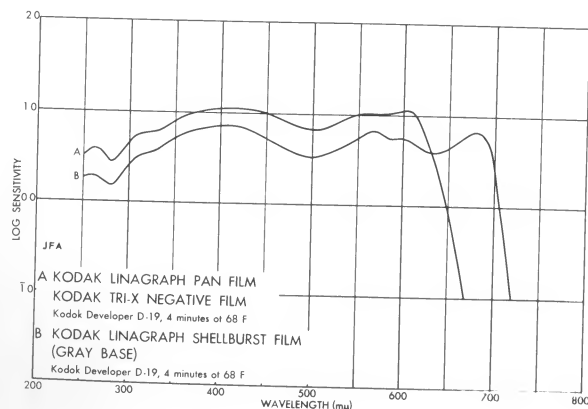


FIGURE 7



RELATIVE CRT SPEEDS

Table II on page 10 shows the relative CRT speeds, or sensitivities to the different phosphors, of the various films as compared with Eastman Television Recording Film, Type 5374.

A speed of 100 was assigned to the Type 5374 film when exposed to a P-11 phosphor and developed in Kodak Developer D-19 for 4 minutes at 68 F (20 C). The speeds for the other films exposed to this phosphor as well as to phosphors P-4, P-15, P-16, and P-24 are relative to the speed of Eastman Television Recording Film, Type 5374, exposed to a P-11 phosphor.

The speeds given in these tables are a measure of the response of the films exposed to the cathode-ray tubes when the same beam current and accelerating voltage are used with the various phosphors.

A very important factor in determining the relative speeds of emulsions is the development to which they are subjected. This is particularly important in data-recording from cathode-ray tubes, because in practical applications many different developing conditions are encountered. The effects of extended development on film speed are shown in Table III on page 11. As an example, among the films developed for 4 minutes and for 15 minutes in D-19, Kodak Photoflure Film, Blue Sensitive was the fastest at 4 minutes, while Kodak Royal-X Pan Recording Film was much slower. At a development time of 15 minutes, however, Kodak Royal-X Pan Recording Film became the faster of the two materials.

CHARACTERISTIC CURVES

The characteristic D-log E curves for the various films are shown in Figures 8 to 28. To avoid excessive crowding it has been necessary to use several figures for each phosphor. In each figure, however, there is a D-log E curve for Eastman Television Recording Film, Type 5374. As explained in the previous section, this film was adopted as a standard and a sample of it was exposed and processed with each group of

(Continued on page 11)

Table II. RELATIVE CRT SPEEDS* OF KODAK FILMS

NORMAL DEVELOPMENT: 4 minutes in Kodak Developer D-19 at 68 F (20 C)

Phosphor	P11	P4	P15	P16	P24
Photoflure, Blue Sensitive	2400	180	60	200	83
Photoflure, Green Sensitive	1800	500	250	130	240
Cineflure	1800	500	250	130	240
Linagraph Ortho	1800	500	250	130	240
Royal Ortho (sheet)	1000	250	130	80	130
Linagraph Pan	900	320	120	82	120
Tri-X Negative	900	320	120	82	120
Linagraph Shellburst	500	180	60	48	73
Eastman High Speed Positive, Type 5305	360	51	25	45	28
Royal-X Pan Recording**	320	150	65	23	47
Eastman Television Recording, Type 5374 and Type 7374	<u>100</u>	<u>11</u>	<u>5.2</u>	<u>7.5</u>	<u>5.2</u>
Eastman Fine Grain Release Positive, Type 5302 and Type 7302	35	4	2	6	2
Kodalith Ortho, Type 3	32	5	8	5	8
High Contrast Copy	20	12	6	4	5

*Measured at a density of 1.0 (net) and relative to the speed of 100 assigned to Eastman Television Recording Film, Type 5374, when exposed to a P-11 phosphor and developed in Kodak Developer D-19 for 4 minutes at 68 F (20 C).

**A greater speed advantage will be realized if Kodak Developer DK-50 is used.

Table III. RELATIVE CRT SPEEDS* OF KODAK FILMS

EXTENDED DEVELOPMENT: (15 minutes in Kodak Developer D-19 at 68 F)

Phosphor	P11	P16	P24
Royal-X Pan Recording	6300	600	1200
Photoflure, Blue Sensitive	5400	500	220
Cineflure	4100	250	360
Linagraph Ortho	4100	250	360
Royal Ortho (sheet)	3900	220	400
Tri-X Negative	2600	200	370
Linagraph Pan	2600	200	370
Linagraph Shellburst	2400	190	260
Eastman High Speed Positive	630	82	25
Eastman Television Recording, Type 5374 and Type 7374	<u>250</u>	<u>19</u>	<u>14</u>

*Measured at a density of 1.0 (net) and relative to the speed of 100 assigned to Eastman Television Recording Film, Type 5374, when exposed to a P-11 phosphor and developed in Kodak Developer D-19 for 4 minutes at 68 F.

(Continued from page 9)

films tested. The curves are identified and exposure conditions are indicated for each figure in the tabulated information on the facing page. To the extent that reciprocity failure and intermittency effects influence the results, the curves for films receiving different exposures are not absolutely comparable. It should also be remembered that these CRT relative speeds may differ from those encountered in conventional photographic applications.

In each case, however, the separation along the log-E axis between the curve for Type 5374 and that for any other film was determined by identical exposures on these two films.

NORMAL DEVELOPMENT - P-11 PHOSPHOR

Development Time: 4 minutes in Kodak Developer D-19 at 68 F (20 C)

Curve Kodak Film Exposure

Figure 8

- | | |
|--|--|
| A. Cineflure; Photoflure, Green Sensitive; and Linagraph Ortho | 1 frame at 4 microamperes plus .6 neutral density filter |
| B. Photoflure, Blue Sensitive | 1 frame at 4 microamperes plus .6 neutral density filter |
| C. Linagraph Pan and Tri-X Negative | 1 frame at 4 microamperes plus .6 neutral density filter |
| D. Royal Ortho | 1 frame at 4 microamperes |
| * Eastman Television Recording, Type 5374 | 1 frame at 60 microamperes |

FIGURE 8

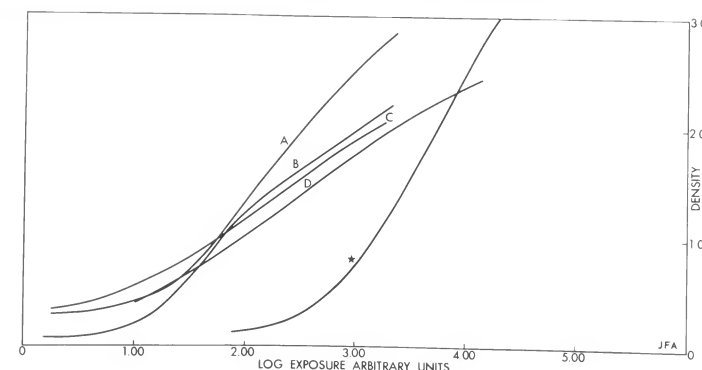


Figure 9

- | | |
|---|--|
| A. Royal-X Pan Recording | 1 frame at 4 microamperes plus .6 neutral density filter |
| B. Linagraph Shellburst | 1 frame at 4 microamperes |
| C. Eastman High Speed Positive, Type 5305 | 1 frame at 15 microamperes |
| * Eastman Television Recording, Type 5374 | 1 frame at 60 microamperes |

FIGURE 9

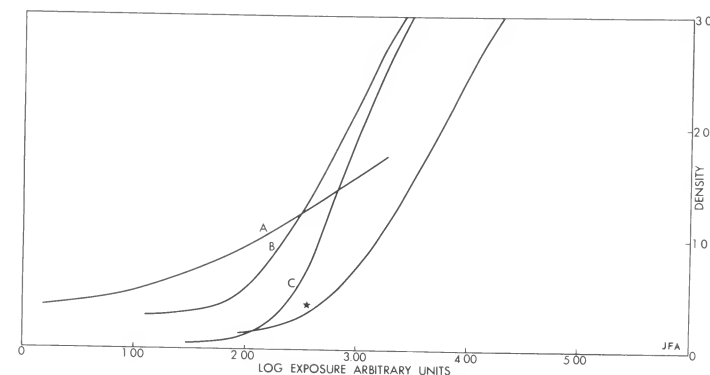
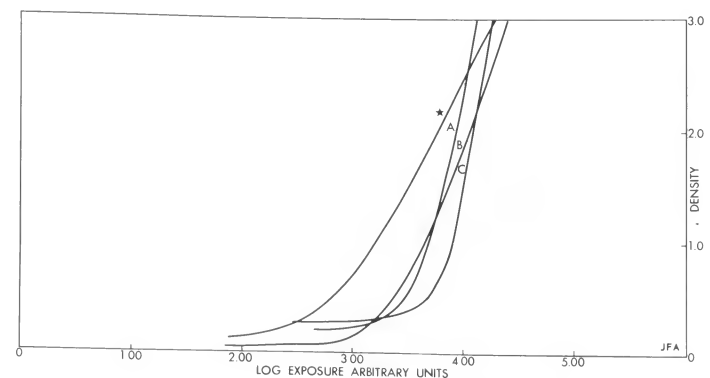


Figure 10

- | | |
|---|-----------------------------|
| A. Kodalith Ortho, Type 3 | 8 frames at 60 microamperes |
| B. Eastman Fine Grain Release Positive, Type 5302 | 1 frame at 60 microamperes |
| C. High Contrast Copy | 1 frame at 60 microamperes |
| * Eastman Television Recording, Type 5374 | 1 frame at 60 microamperes |

FIGURE 10



NORMAL DEVELOPMENT - P-4 PHOSPHOR

Curve Kodak Film Exposure

Figure 11

- | | |
|--|----------------------------|
| A. Cineflure; Photoflure, Green Sensitive; and Linagraph Ortho | 1 frame at 4 microamperes |
| B. Linagraph Pan and Tri-X Negative | 1 frame at 4 microamperes |
| C. Royal Ortho | 1 frame at 4 microamperes |
| D. Photoflure, Blue Sensitive | 1 frame at 15 microamperes |
| * Eastman Television Recording, Type 5374 | 1 frame at 60 microamperes |

Development Time: 4 minutes in Kodak Developer D-19 at 68 F (20 C)

FIGURE 11

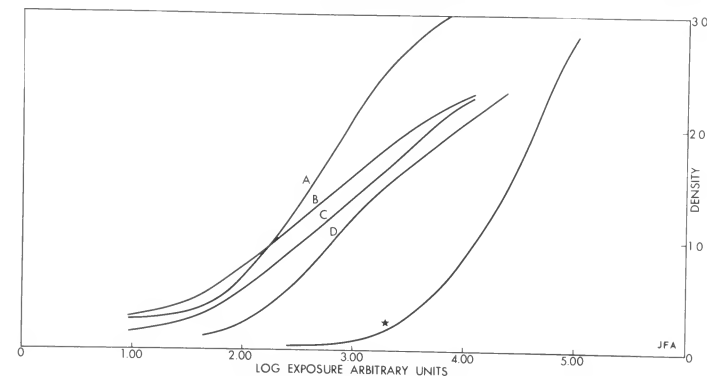


Figure 12

- | | |
|---|----------------------------|
| A. Linagraph Shellburst | 1 frame at 15 microamperes |
| B. Royal-X Pan Recording | 1 frame at 4 microamperes |
| C. Eastman High Speed Positive, Type 5305 | 1 frame at 60 microamperes |
| * Eastman Television Recording, Type 5374 | 1 frame at 60 microamperes |

FIGURE 12

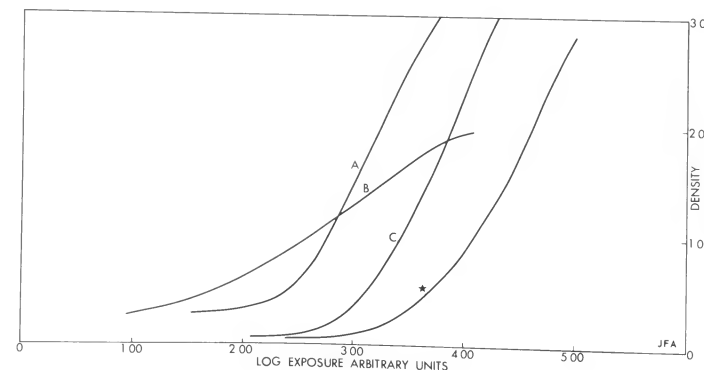
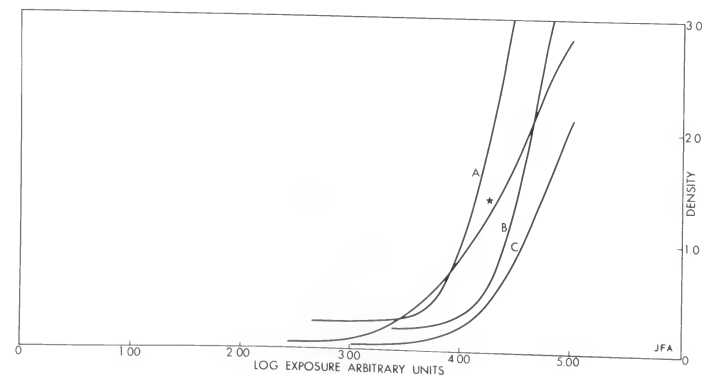


Figure 13

- | | |
|---|----------------------------|
| A. High Contrast Copy | 1 frame at 60 microamperes |
| B. Kodalith Ortho, Type 3 | 1 frame at 60 microamperes |
| C. Eastman Fine Grain Release Positive, Type 5302 | 1 frame at 60 microamperes |
| * Eastman Television Recording, Type 5374 | 1 frame at 60 microamperes |

FIGURE 13



NORMAL DEVELOPMENT - P-15 PHOSPHOR

Development Time: 4 minutes in Kodak Developer D-19 at 68 F (20 C)

Curve	Kodak Film	Exposure
Figure 14		
A.	Cineflure; Photoflure, Green Sensitive; and Linagraph Ortho	1 frame at 15 microamperes
B.	Linagraph Pan and Tri-X Negative	1 frame at 4 microamperes
C.	Royal Ortho	1 frame at 15 microamperes
D.	Photoflure, Blue Sensitive	1 frame at 60 microamperes
★	Eastman Television Recording, Type 5374	16 frames at 60 microamperes

FIGURE 14

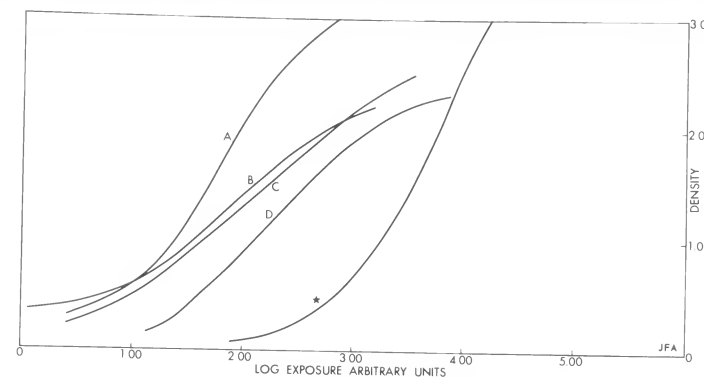


Figure 15		
A.	Linagraph Shellburst	1 frame at 60 microamperes
B.	Royal-X Pan Recording	1 frame at 15 microamperes
C.	Eastman High Speed Positive, Type 5305	4 frames at 60 microamperes
★	Eastman Television Recording, Type 5374	16 frames at 60 microamperes

FIGURE 15

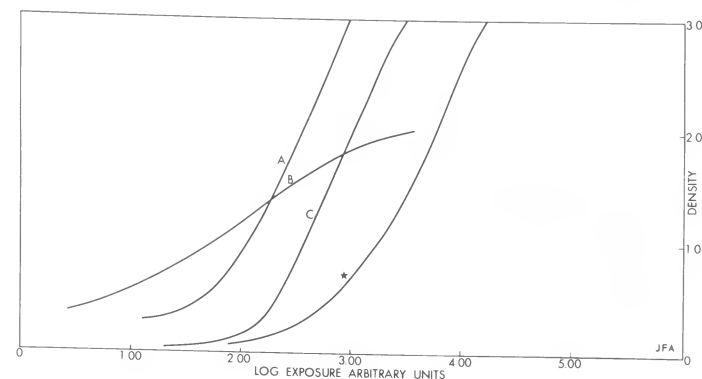
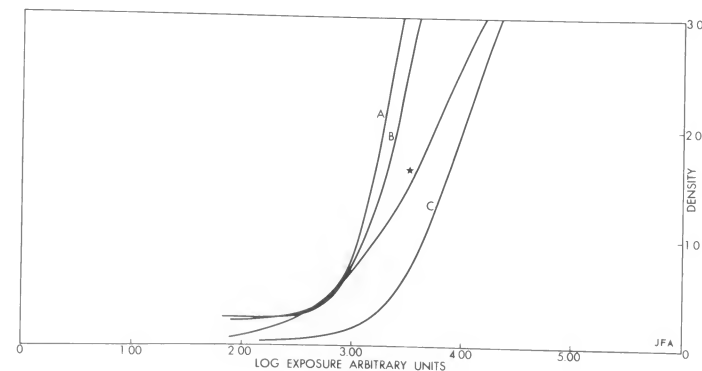


Figure 16		
A.	Kodalith Ortho, Type 3	16 frames at 60 microamperes
B.	High Contrast Copy	16 frames at 60 microamperes
C.	Eastman Fine Grain Release Positive, Type 5302	16 frames at 60 microamperes
★	Eastman Television Recording, Type 5374	16 frames at 60 microamperes

FIGURE 16



NORMAL DEVELOPMENT - P-16 PHOSPHOR

Development Time: 4 minutes in Kodak Developer D-19 at 68 F (20 C)

Curve	Kodak Film	Exposure
Figure 17		
A. Cineflure; Photoflure, Green Sensitive; and Linagraph Ortho		1 frame at 15 microamperes
B. Photoflure, Blue Sensitive		1 frame at 15 microamperes
C. Linagraph Pan and Tri-X Negative		1 frame at 15 microamperes
D. Royal Ortho		1 frame at 15 microamperes
* Eastman Television Recording, Type 5374		8 frames at 60 microamperes

FIGURE 17

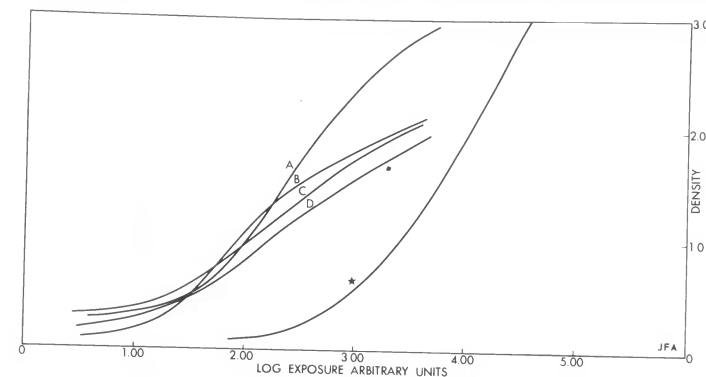


Figure 18		
A. Linagraph Shellburst		1 frame at 60 microamperes
B. Eastman High Speed Positive, Type 5305		1 frame at 60 microamperes
C. Royal-X Pan Recording		1 frame at 15 microamperes
* Eastman Television Recording, Type 5374		8 frames at 60 microamperes

FIGURE 18

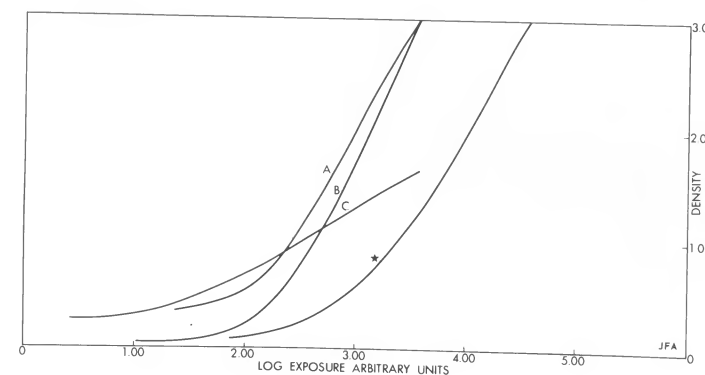


FIGURE 19

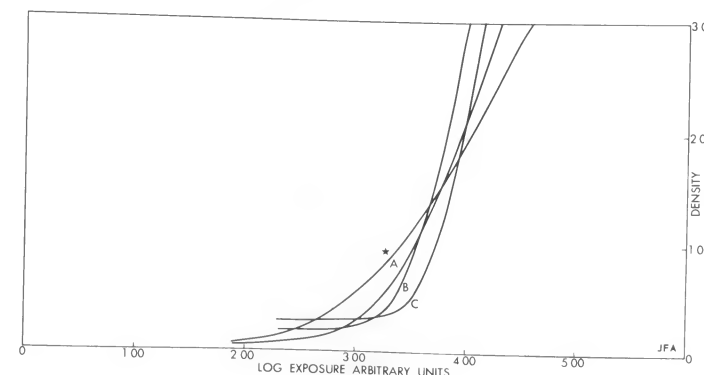


Figure 19		
A. Eastman Fine Grain Release Positive, Type 5302		8 frames at 60 microamperes
B. Kodalith Ortho, Type 3		16 frames at 60 microamperes
C. High Contrast Copy		8 frames at 60 microamperes
* Eastman Television Recording, Type 5374		8 frames at 60 microamperes

NORMAL DEVELOPMENT - P-24 PHOSPHOR

Development Time: 4 minutes in Kodak Developer D-19 at 68 F (20 C)

Curve	Kodak Film	Exposure
Figure 20		
A. Cineflure; Photoflure, Green Sensitive; and Linagraph Ortho		1 frame at 15 microamperes
B. Linagraph Pan and Tri-X Negative		1 frame at 15 microamperes
C. Royal Ortho		1 frame at 15 microamperes
D. Photoflure, Blue Sensitive		1 frame at 15 microamperes
* Eastman Television Recording, Type 5374		16 frames at 60 microamperes

FIGURE 20

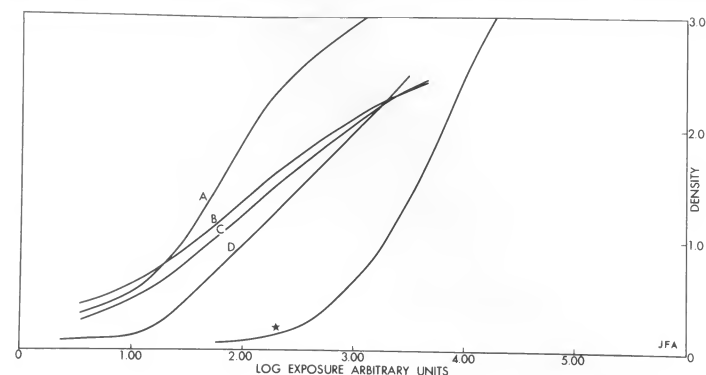


Figure 21		
A. Linagraph Shellburst		1 frame at 15 microamperes
B. Royal-X Pan Recording		1 frame at 15 microamperes
C. Eastman High Speed Positive, Type 5305		4 frames at 60 microamperes
* Eastman Television Recording, Type 5374		16 frames at 60 microamperes

FIGURE 21

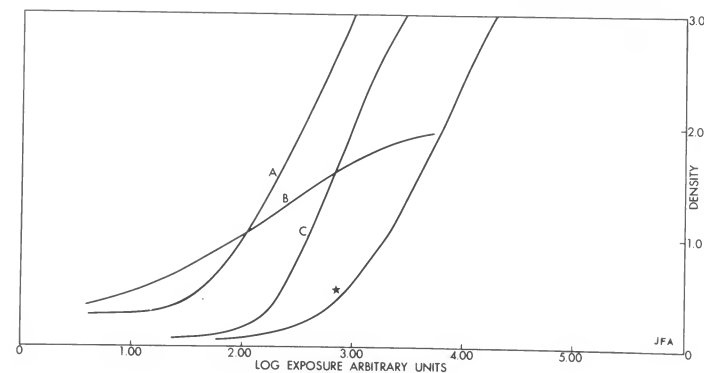
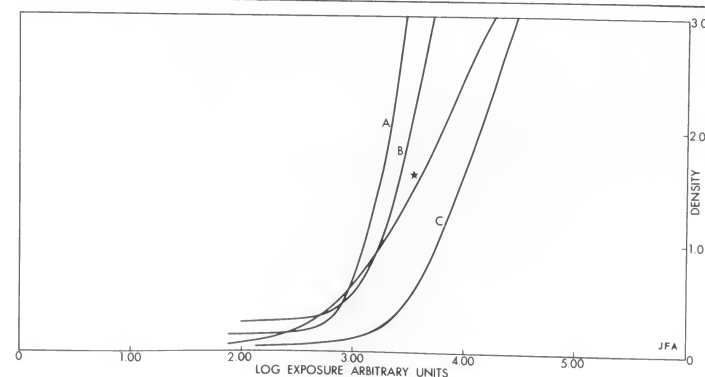


Figure 22		
A. Kodalith Ortho, Type 3		16 frames at 60 microamperes
B. High Contrast Copy		16 frames at 60 microamperes
C. Eastman Fine Grain Release Positive, Type 5302		16 frames at 60 microamperes
* Eastman Television Recording, Type 5374		16 frames at 60 microamperes

FIGURE 22



EXTENDED DEVELOPMENT

Development Time: 15 minutes in Kodak Developer D-19 at 68 F (20 C), unless otherwise noted.

Curve	Kodak Film	Exposure
Figure 23	P-11 PHOSPHOR	
A. Cineflure; Photoflure, Green Sensitive; and Linagraph Ortho		1 frame at 4 microamperes plus 1.2 neutral density filter
B. Photoflure, Blue Sensitive		1 frame at 4 microamperes plus .6 neutral density filter
C. Royal-X Pan Recording		1 frame at 4 microamperes plus .6 neutral density filter
D. Royal Ortho		1 frame at 4 microamperes plus 1.2 neutral density filter
E. Eastman Television Recording, Type 5374		1 frame at 15 microamperes
* Eastman Television Recording, Type 5374 (4 min. development)		1 frame at 60 microamperes

Figure 24

Curve	Kodak Film	Exposure
Figure 24	P-11 PHOSPHOR	
A. Linagraph Shellburst		1 frame at 4 microamperes plus .6 neutral density filter
B. Tri-X Negative and Linagraph Pan		1 frame at 4 microamperes plus 1.2 neutral density filter
C. Eastman High Speed Positive, Type 5305		1 frame at 4 microamperes
D. Eastman Television Recording, Type 5374		1 frame at 15 microamperes
* Eastman Television Recording, Type 5374 (4 min. development)		1 frame at 60 microamperes

Figure 25

Curve	Kodak Film	Exposure
Figure 25	P-16 PHOSPHOR	
A. Royal-X Pan Recording		1 frame at 4 microamperes
B. Photoflure, Blue Sensitive		1 frame at 4 microamperes
C. Cineflure; Photoflure, Green Sensitive; and Linagraph Ortho		1 frame at 4 microamperes
D. Royal Ortho		1 frame at 4 microamperes
E. Eastman Television Recording, Type 5374		1 frame at 60 microamperes
* Eastman Television Recording, Type 5374 (4 min. development)		8 frames at 60 microamperes

FIGURE 23

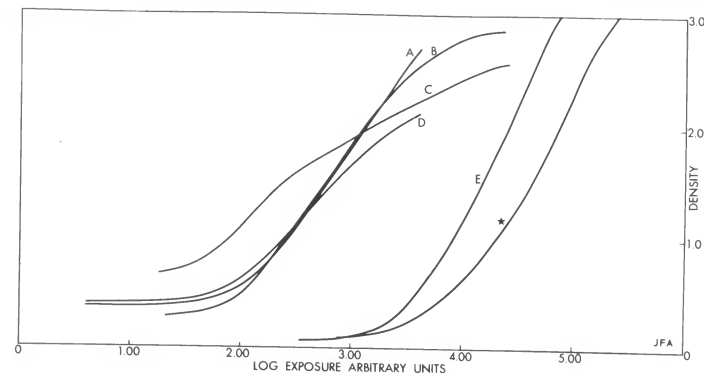


FIGURE 24

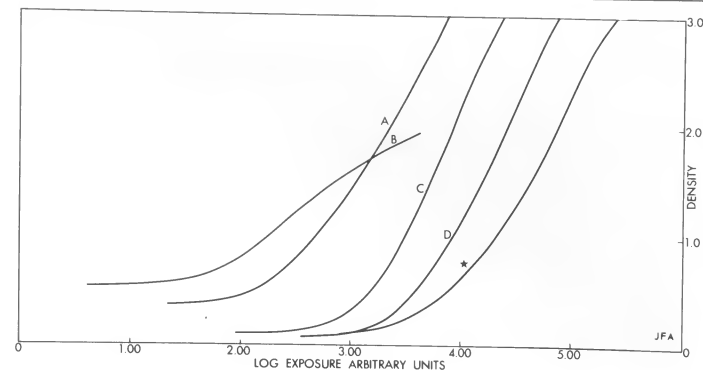
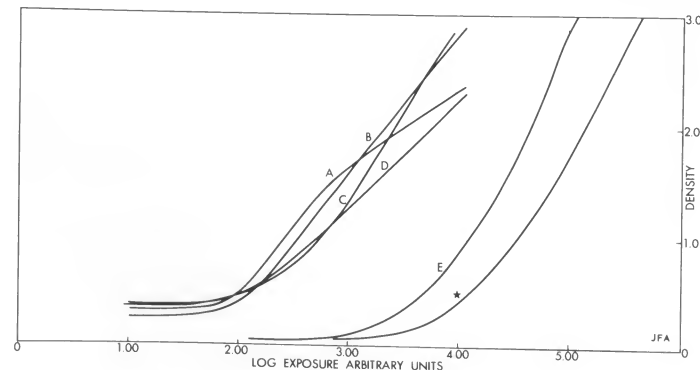


FIGURE 25



EXTENDED DEVELOPMENT

Development Time: 15 minutes in Kodak Developer D-19 at 68 F (20 C), unless otherwise noted.

Curve Kodak Film Exposure

Figure 26

P-16 PHOSPHOR

- | | |
|--|-----------------------------|
| A. Tri-X Negative and Linagraph Pan | 1 frame at 4 microamperes |
| B. Linagraph Shellburst | 1 frame at 4 microamperes |
| C. Eastman High Speed Positive, Type 5305 | 1 frame at 60 microamperes |
| D. Eastman Television Recording, Type 5374 | 1 frame at 60 microamperes |
| * Eastman Television Recording, Type 5374 (4 min. development) | 8 frames at 60 microamperes |

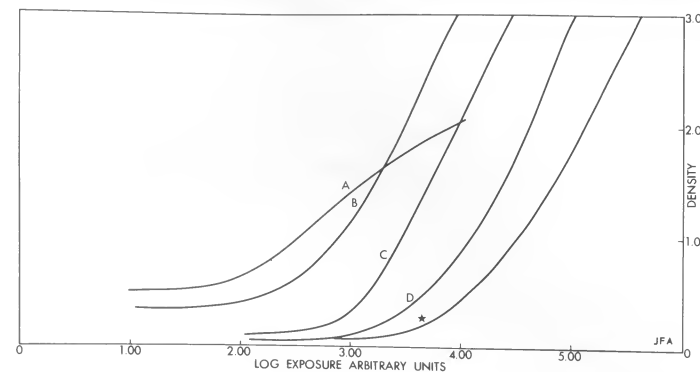


FIGURE 26

Figure 27

P-24 PHOSPHOR

- | | |
|--|------------------------------|
| A. Royal-X Pan Recording | 1 frame at 4 microamperes |
| B. Cineflure; Photoflure, Green Sensitive; and Linagraph Ortho | 1 frame at 4 microamperes |
| C. Royal Ortho | 1 frame at 4 microamperes |
| D. Photoflure, Blue Sensitive | 1 frame at 4 microamperes |
| E. Eastman Television Recording, Type 5374 | 4 frames at 60 microamperes |
| * Eastman Television Recording, Type 5374 (4 min. development) | 16 frames at 60 microamperes |

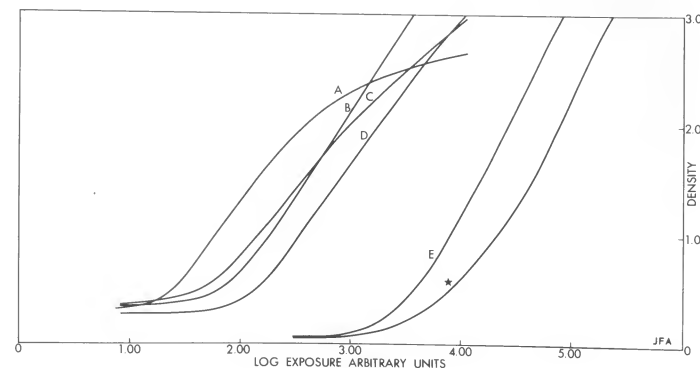


FIGURE 27

Figure 28

P-24 PHOSPHOR

- | | |
|--|------------------------------|
| A. Linagraph Shellburst | 1 frame at 4 microamperes |
| B. Tri-X Negative and Linagraph Pan | 1 frame at 4 microamperes |
| C. Eastman High Speed Positive, Type 5305 | 1 frame at 60 microamperes |
| D. Eastman Television Recording, Type 5374 | 4 frames at 60 microamperes |
| * Eastman Television Recording, Type 5374 (4 min. development) | 16 frames at 60 microamperes |

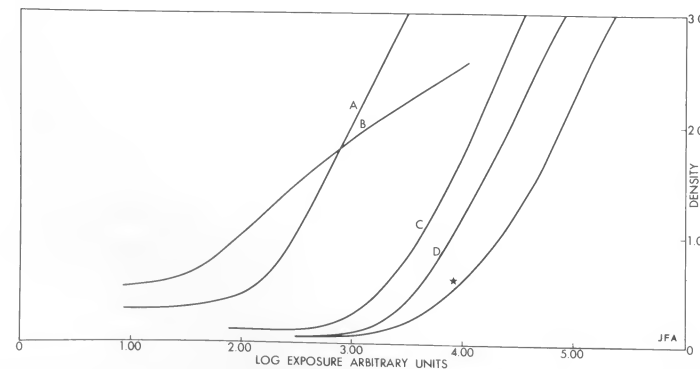


FIGURE 28

IMAGE-STRUCTURE CHARACTERISTICS

Graininess

The relative values given below are based on measurement at a density of 1.0 above support density. All films were developed for 4 minutes in Kodak Developer D-19 at 68 F.

Extremely Fine:

Kodak High Contrast Copy Film
Kodalith Ortho Film, Type 3
Eastman Fine Grain Release Positive Film,
Type 5302 and Type 7302

Very Fine:

Eastman Television Recording Film,
Type 5374 and Type 7374

Fine:

Eastman High Speed Positive Film, Type 5305

Medium:

Kodak Linagraph Shellburst Film (Gray Base)

Moderately Coarse:

Kodak Linagraph Ortho Film (Gray Base)
Kodak Linagraph Pan Film
Kodak Tri-X Negative Film
Kodak Cineflure Film
Kodak Photoflure Film, Green Sensitive
Kodak Royal Ortho Film

Coarse:

Kodak Royal-X Pan Recording Film
Kodak Photoflure Film, Blue Sensitive

Modulation Transfer

Figures 29 through 37 show the modulation transfer characteristics of the various films. This was formerly called "sine-

wave response," and indicates the effects on the microstructure of the image caused by diffusion of light within the image, adjacency effects in development, and other such factors.

In obtaining these data, patterns having a sinusoidal variation in illuminance in one direction are exposed onto the film. The "modulation" of each pattern can be expressed by the

formula $M_O = \frac{E_{\max} - E_{\min}}{E_{\max} + E_{\min}}$. After development, the photo-

graphic image is scanned in a microdensitometer, the densities of the trace are interpreted in terms of exposure, and the effective modulation of the image M_i , is calculated. The modulation transfer is the ratio of the modulation of the developed image to the modulation of the exposing pattern, or $\frac{M_i}{M_O}$. The modulation transfer curves show a plot of this ratio

as a function of the spatial frequency of the patterns in cycles per millimeter.

By suitable mathematical operations, the modulation transfer data for a film can be combined with similar data for the optical system with which it will be used, to predict the image-detail characteristics.

More detailed information and help in working with modulation transfer (sine-wave response) can be found in "Methods of Appraising Photographic Systems" by F. H. Perrin.¹ Part 1 of this article gives historical background, while Part 2 discusses the "Manipulation and Significance of the Sine-Wave Response Function." An extensive bibliography is included.

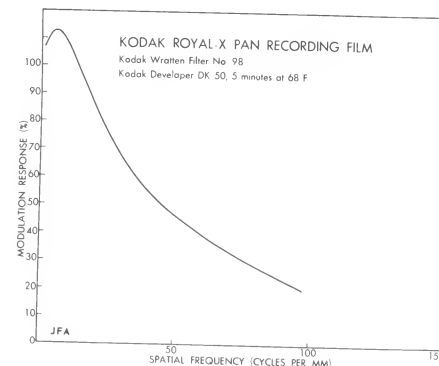


FIGURE 29

1. *Journal of the SMPTE (Society of Motion Picture and Television Engineers)*, Vol. 69, pp. 151-156, March, and pp. 239-249, April, 1960.

FIGURE 30

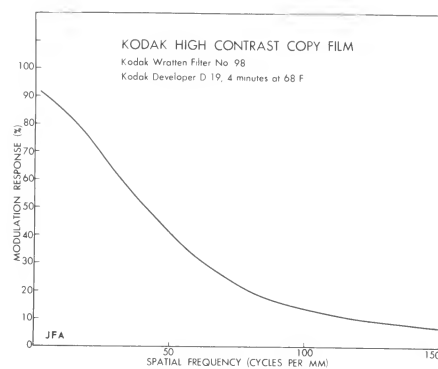


FIGURE 31

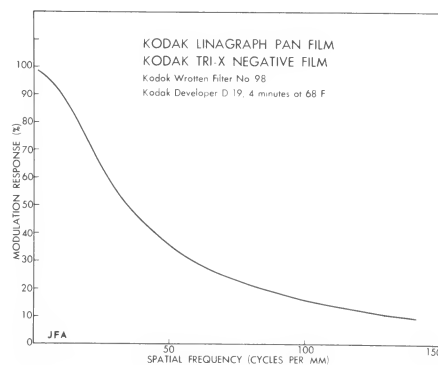


FIGURE 32

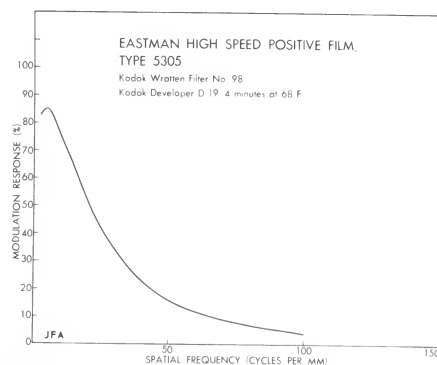


FIGURE 33

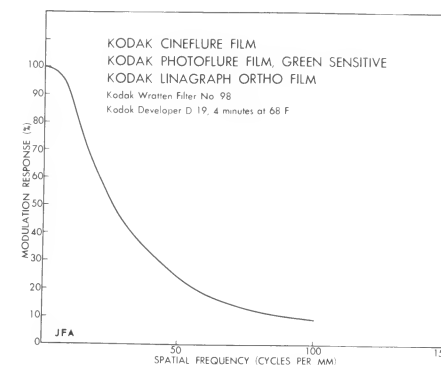


FIGURE 34

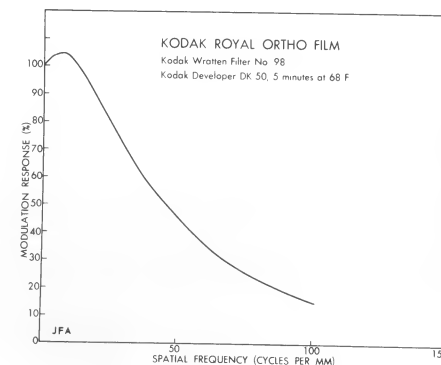


FIGURE 35

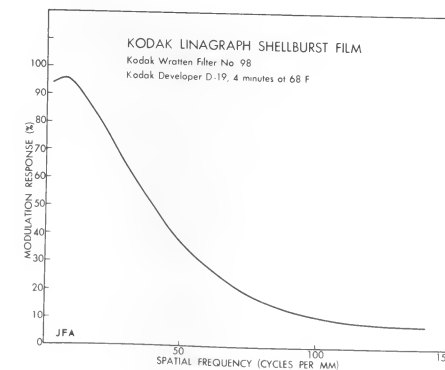


FIGURE 36

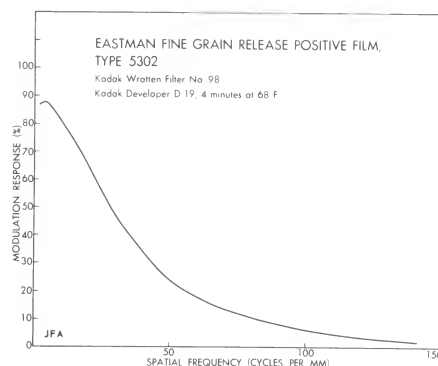
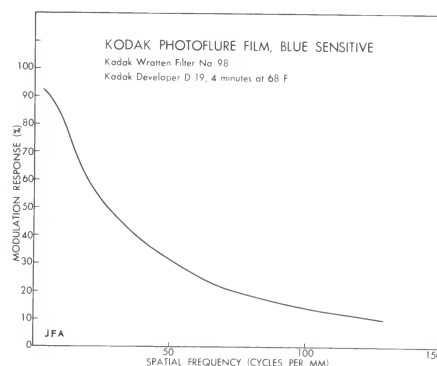


FIGURE 37



RAPID PROCESSING – EMULSION HARDNESS

In cathode-ray tube photography it is often necessary to view test results as quickly as possible. Therefore, one of the important considerations in the choice of a film is whether or not the emulsion can withstand processing at elevated temperatures. Also, quite often the effective speed of a film can be changed by processing at higher temperatures. All the films in this data book are classified on the next page according to their suitability for high-temperature processing.²

2. A Short Annotated Bibliography on Rapid Processing, published by the Department of Information Services, Research Laboratories, Eastman Kodak Company, Rochester 4, N. Y., is available on request.

Emulsion Hardness

Soft – for processing at temperatures up to 75 F (24 C)

Kodak Linagraph Pan Film
Kodak Tri-X Negative Film
Kodak Photoflure Film, Blue Sensitive

Moderately Hard – for processing at temperatures up to 90 F (32 C)

Kodak Linagraph Ortho Film
Kodak Cineflure Film
Kodak Photoflure Film, Green Sensitive
Kodak High Contrast Copy Film
Eastman High Speed Positive Film, Type 5305
Kodak Royal-X Pan Recording Film
Kodak Royal Ortho Film
Kodak Linagraph Shellburst Film

Very Hard – for processing at temperatures up to 130 F (54 C)

Eastman Television Recording Film, Type 5374 and Type 7374
Kodalith Ortho Film, Type 3
Eastman Fine Grain Release Positive Film, Type 5302 and Type 7302

SIZES AND ORDERING INFORMATION

The films and the sizes given in the table on page 32 are available from your Kodak dealer unless otherwise noted. For other sizes or additional information, write to:

Special Sensitized Products Sales Division
Eastman Kodak Company
Rochester 4, New York

Films are listed in their descending order of sensitivity when exposed to a P-11 phosphor.

KODAK FILM	PREFIX	IDENTIFICATION and/or SPECIFICATION NUMBERS			
		16mm	35mm	70mm	SHEET-FILMSIZES (in inches)
Photoflure, Blue Sensitive	PFB			470	
Cineflure	CFG	449			
Photoflure, Green Sensitive	PFG		135-36; 402,414 713-2	469,470	
Linagraph Ortho (Gray Base)	LOG	430,449	414,415, 417, 421-1	475,477	
Royal Ortho (sheet)	—				2¼x3¼, 2½x3½, 3¼x4¼, 4x5, 5x7, 6½x8½, 8x10, 6½x9cm, 9x12cm
Tri-X Negative	TXN	430, 432, 433-4, 434,449, 450,455, 456	415,417, 418-4		
Linagraph Pan	LP	430,449	414,415, 417, 421-1		
Linagraph Shellburst (Gray Base)	SG	449	417, 421-1, 421-2, 713-4, Sp713	476,477	

KODAK FILM	PREFIX	IDENTIFICATION and/or SPECIFICATION NUMBERS			
		16mm	35mm	70mm	SHEET-FILMSIZES (in inches)
Eastman High Speed Positive,* Type 5305 (35mm)	—		Sp660 in 400 and 1,000-ft rolls for each specification Sp714		
Royal-X Pan Recording	—	Sp430	Sp417	Sp475	
Eastman Television Recording,* Type 5374 (35mm) Type 7374 (16mm)	—	Sp451, Sp457 in 1,200- ft rolls	Sp660 in 1,000-ft rolls		
Eastman Fine Grain Release Positive,* Type 5302 (35mm) and 7302 (16mm)	—	Sp451, Sp457 in 400- and 1,200- and 2,000-ft rolls Sp612 in 1,200- and 2,000-ft rolls	Sp663 in 1,000- and 2,000-ft rolls Sp714 in 1,000-ft rolls		
Kodalith Ortho, Type 3 (sheet)	—				4x5, 5x7, 6½x8½, 8x10, 8½x11, 10x12, 11x14
High Contrast Copy	M		135-36, 402,417		

*Eastman motion-picture films for professional use are available in the United States only from: W. J. German, Inc., Jane Street, Fort Lee, New Jersey
6040 Pulaski Road, Chicago 30, Illinois
6677 Santa Monica Boulevard, Hollywood 38, California

Description of Identification and Specification (Sp) Numbers

NOTE: When an identification or specification number listed for a particular film is followed by a hyphen and 1 or 2 digits, the number following the hyphen indicates length of the roll in hundreds of feet. This does not apply to numbers listed for 35mm film in magazines. (See "35mm Magazine" section, page 36.)

402: 35mm x 100 ft, darkroom load, Kodak Standard perforations, on Type AA plastic core, frame-numbered.

414: 35mm x 100 ft, subdued-light load, unperforated, on No. 10 spool (S-83). All clear-base films — spliced leader and trailer. All gray-base and films with removable black backing — integral leader and trailer. Small edge printed.

415: 35mm x 100 ft, subdued-light load, K.S. perforations, on No. 10 spool (S-83), for 35mm high-speed cameras. Footage numbered, with integral leader and trailer.

417: 35mm x 100 ft, subdued-light load, B.&H. perforations, on No. 10 spool (S-83). All clear-base films — spliced leader and trailer. All gray-base and films with removable black backing — integral leader and trailer. For Ophthalmograph, Eyemo, De Vry, and similar cameras; Graflex Photorecord Microfilm Outfit and 35mm Graflex Photorecord Identification Unit or Camera.

418: 35mm, darkroom load, K.S. perforations, on Type R Tenite core, for 35mm high-speed cameras. Footage numbered.

421: 35mm, darkroom load, B.&H. perforations, on Type AA plastic core.

430: 16mm x 100 ft, subdued-light load, perforated two edges with .300-inch pitch, on Kodak spool (S-90), for 16mm high-speed cameras. Footage numbered, with integral leader and trailer.

432: 16mm x 200 ft, subdued-light load, perforated two edges with .300-inch pitch, on Kodak spool (S-94), for 16mm high-speed cameras. Footage numbered, with integral leader and trailer.

433: 16mm, darkroom load, perforated two edges with .300-inch pitch, on Type T Tenite core, for high-speed cameras. Special order. Footage numbered.

434: 16mm x 400 ft, subdued-light load, perforated two edges with .300-inch pitch, on S-153 camera spool.

449: 16mm x 100 ft, subdued-light load, perforated two edges on Kodak spool (S-90), for silent pictures. All clear-base films — spliced leader and trailer. All gray-base and films with removable black backing — integral leader and trailer.

450: 16mm x 200 ft, on Kodak spool (S-94). Otherwise, same as 449.

451: 16mm, darkroom load, perforated two edges, on Type T Tenite core, for silent pictures. Special order.

455: 16mm x 100 ft, subdued-light load, perforated one edge on Kodak spool (S-90), for sound pictures. Winding B. All clear-base films — spliced leader and trailer. All gray-base and films with removable black backing — integral leader and trailer.

456: 16mm x 200 ft, on Kodak spool (S-94). Otherwise, same as 455.

457: 16mm, darkroom load, perforated one edge, on Type T Tenite core, for sound pictures. Special order. Winding B supplied. If Winding A is desired, order by Sp612.

469: 70mm x 100 ft, unperforated, on No. 10 spool (S-84). Integral leader and trailer for darkroom loading for the Fairchild-Odelco, Super Speed Photofluorographic, and Phillips Automirror cameras.

470: 70mm x 100 ft, unperforated, on No. 10 spool (S-84), for Fairchild Fluoro-Record Camera, F-212. Darkroom load with special-perforated, black film leader and unperforated trailer.

475: 70mm x 100 ft, Type II perforations, on No. 10 spool (S-84). All clear-base films — spliced leader and trailer. All gray-base and films with removable black backing — integral leader and trailer.

476: 70mm x 100 ft, darkroom load, Type I perforations, on Type X plastic core.

477: 70mm x 100 ft, subdued-light load, Type I perforations, on No. 10 spool (S-84). For Hulcher and similar cameras. All

clear-base films — spliced leader and trailer. All gray-base and films with removable black backing — integral leader and trailer.

612: 16mm darkroom load, perforated one edge on Type T Tenite Core for sound pictures. Winding A.

660: 35mm, K.S. perforations on Type R Tenite Core, dark-room load. Footage numbered.

663: 35mm, K.S. perforations on Type U Tenite core, dark-room load.

713: 35mm, B.&H. perforations, on Type R Tenite core, dark-room load.

714: 35mm, B.&H. perforations, on Type R Tenite core, dark-room load. Footage numbered.

35mm Magazine

135-36: 35mm, K.S. perforations, in 36-exposure magazines.

Ordering Films

In orders for any of the listed films, except those with "Eastman" as a prefix, the following information is required:

- a. Number of rolls desired.
- b. Sizes, width, and length.
- c. Film name.
- d. Prefix letters and identification numbers or Specification (Sp) numbers. Do not use prefix letters before Specification numbers.

Examples:

- 2 rolls, 16mm x 100 ft, Kodak Tri-X Negative Film, TXN430
- 2 rolls, 16mm x 100 ft, Kodak Royal-X Pan Recording Film, Sp430

Orders for any of the Eastman motion-picture films from W. J. German, Inc. should be written as follows:

- a. Total length (length of each roll times number of rolls) and width of film desired.
- b. Film name, including type number.
- c. Type of perforations and winding.
- d. Number of feet in each roll.

Example:

12,000 ft, 16mm Eastman Television Recording Film, Type 7374, Sound B, 1200.

OTHER KODAK PUBLICATIONS

which are of interest to technical Photographers

Kodak Plates and Films for Science and Industry (P-9). Specific information on the characteristics of Kodak Spectroscopic Plates and Films as well as Kodak plates and films for other technical uses. Illustrated. \$1.00

Infrared and Ultraviolet Photography (M-3). Information compiled to assist photographers with or without experience in these fields. Technical procedures are described in detail and a brief bibliography is included. 48 pp. Illustrated. \$1.00

Kodak Wratten Filters for Scientific and Technical Use (B-3). A 78-page booklet of data and spectrophotometric curves on the line of Kodak Wratten Filters. \$1.00

Kodak Photographic Notebook (W-22). Allows you to build your own photographic reference manual, tailored to your interests. It has a transparent pocket on the backbone into which an appropriate title strip can be inserted (a number of these are supplied). Easily holds six Kodak Data Books plus a number of small pamphlets and personal notes. Includes a set of tabbed pages for indexing and a supply of blank notebook paper. A registration card entitles you to receive periodic notification of new or revised Kodak publications. \$1.95

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Sales Service Division
Eastman Kodak Company
343 State Street
Rochester 4, New York

Important: Such orders should give title of publication and code number and include remittance.

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3-62 New Publication

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